

Six Collembolan Species (Insecta) New to Korea Including Two species from Ant Nests

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ABSTRACT

This study deals with 8 species in 3 families of Collembola including 6 new records of Korea. They are *Oudemansia esakii* (Kinoshita, 1932), *Axelsonia littoralis* (Moniez, 1890), *Sinella* (s. str.) *straminea* (Folsom, 1899), *Sinella* (s. str.) *coeca* (Schött, 1899), *Entomobrya marginata* (Tullberg, 1871), and *Willowsia bimaculata* (Börner, 1909). Among them *Oudemansia esakii*, *Axelsonia littoralis* and *Entomobrya marginata* are halophilous species. *Sinella straminea* and *Sinella coeca* were collected from nests of ants comprising the first report of myrmecophilous Collembola from Korea. The Collembolan fauna of Korea is accordingly listed as 203 species in 10 families.

Key words: systematics, Collembola, Insecta, Korea

INTRODUCTION

Collembola are small, primitive soil insects and their habitat varies greatly. They are ubiquitous, being found in all terrestrial biomes, including mountain tops, polar regions and deserts. Many species inhabit caves as well as marine and fresh water littoral areas. Collembola are often found in animal nests including those of vertebrates and social insects (Greenslade, 1991). As a result of its world-wide distribution, approximately 6,500 species have been reported throughout the world (Hopkin, 1997).

The collembolan fauna of Korea has been studied by a number of workers including the present

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authors (Lee and Park, 1984, 1986, 1992; Park and Lee, 1995). It resulted in enumeration of 197 species in 62 genera of Collembola.

We collected the collembolan specimens from littoral zones, ant nests, dry cultivated plants, and from the pear trees. The present investigation has revealed 6 species new to the Korean peninsula in addition to two already on record. For three species with minor differences from the original descriptions among the six new records, a brief description and the plates are introduced. The specimens examined are deposited in the Insect Collection, Faculty of Biological Sciences, Chonbuk National University, Chonju, Republic of Korea.

MATERIALS AND METHODS

Materials for this paper were collected from eight different localities in South Korea from 1997 to 1999. Collembola were directly collected using brush or aspirator. They were also extracted by using Tullgren funnels. Collembolans obtained were fixed in 90% ethyl alcohol. We made preparations using Marc André I (or 10% KOH) for decoloration of materials and Marc André II for mounting them on slide glasses. They were, then, examined under the microscope.

DESCRIPTIONS

Family Neanuridae

1. *Oudemansia esakii* (Kinoshita, 1932) 곰보해안흑무늬톡토기 (신칭) (Fig. 1)

Pseudachorutes esaki: Kinoshita, 1932.

Oudemansia esakii: Yosii, 1958, 1960, 1971; Christiansen and Bellinger, 1992, 1998.

Material examined. 1 ♂, 3 ♀, Pokgyo-ri, Taeya-myön, Okku-gun, Chöllabuk-do, 16 Dec. 1997, collected from mid- and lower intertidal zones of salt marsh of Mankyung River with well developed *Sueda japonica* community; 13 ♂, 20 ♀, Chulp'o-myön, Puan-gun, Chöllabuk-do, 28 Mar. 1998, 23 May 1998, 24 Apr. 1999, 18 Jun. 1999, from mud in mid- and lower intertidal zones of Chulp'o beach with well developed *Sueda japonica* community; 22 ♂, 31 ♀, Songhyön-ri, Mangun-myön, Muan-gun, Cöllanam-do, 18 Apr. 1998, 16 Jun. 1998, 10 Oct. 1998, 21 Mar. 1999, 15 May 1999, from mud in intertidal zone of Jokumdari covered with *Enteromorpha linza* community.

Description. Body up to 2 mm long and dark purple-blue. Length of antenna short: antenna and diagonal of head 15 : 17. 3rd and 4th antennal segments were divided in ventral only. Forth antennal segment with clear trilobed apical bulb, placed in dorsal ca. 6 curved sensory setae. 8+8 eyes, subequal, with 4, 1, 3 arrangement (Fig. 1B). Postantennal organ absent. Mandible with 2 large apical teeth and ca. 8 smaller intermediate teeth. Head of maxillae feebly bent, pointed, approximately triangular (Fig. 1C). Unguis with a inner teeth at about the middle. Unguiculus and tenent hair absent (Fig. 1A).

Ventral tube with 2+2 setae (Fig. 1D). Tenaculum rounded, with 3+3 teeth. Furca well developed. Dens with six dorsal setae about 2.3 times as long as mucro and dorsally granulated. Mucro

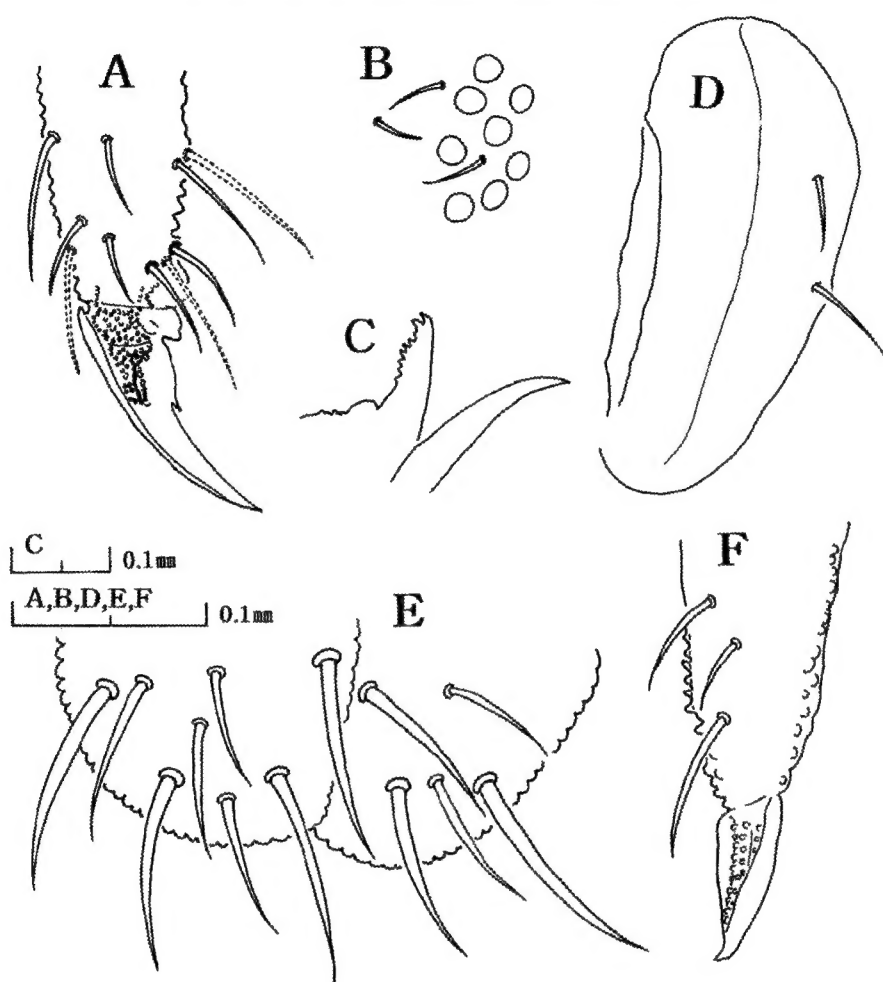


Fig. 1. *Oudemansia esakii* (Kinoshita, 1932). A, hind claw; B, right eye; C, mandible and maxilla; D, right part of ventral tube; E, posterior end of abdomen VI (dorsal view); F, mucro and dens (dorsal view).

boat-like in appearance, with central portion strongly granulate (Fig. 1F).

Remarks. Our specimens agreed with the descriptions by Yosii (1958) from Japan and Christiansen and Bellinger (1992) from Hawaii. However, our specimens differed from those of the descriptions in three details of the body. The structure and teeth formulae of the mandible differ from the materials from Seto and Manazuru in Japan. Also the maxillae is not so styliform as that figured by Yosii (1958). They differed from Christiansen and Bellinger (1992) by the smaller number of the setae in ventral tube; the present materials with 2+2 setae. This species was collected for our ecological survey in 1998 and 1999. This is a new record for Korea. This species is marine intertidal animal.

Distributions. Japan, Hawaii, Korea.

Family Isotomidae

2. *Axelsonia littoralis* (Moniez, 1890) 해안마디톡토기 (신칭) (Fig. 2)

Axelsonia littoralis: Denis, 1923, 1924; Yosii, 1955, 1966; Stach, 1947.

Isotomurus littoralis: Gisin, 1960.

Material examined. 2 ♀, Pokgyo-ri, Taeya-myŏn, Okku-gun, Chŏllabuk-do, 16 Dec. 1997, collected from mid- and lower intertidal zones of salt marsh of Mankyung River with well developed *Sueda japonica* community; 13 ♂, 17 ♀, Chulp'o-myŏn, Puan-gun, Chŏllabuk-do, 28 Mar. 1998, 23 May 1998, 24 Apr. 1999, 18 Jun. 1999, from mud in mid- and lower intertidal zones of Chulp'o beach with well developed *Sueda japonica* community; 11 ♂, 23 ♀, Songhyŏn-ri, Mangun-myŏn, Muan-gun, Chŏllanam-do, 18 Apr. 1998, 16 Jun. 1998, 10 Oct. 1998, 21 Mar. 1999, 15 May 1999, from mud in intertidal zone of Jokumdari covered with *Enteromorpha linza*

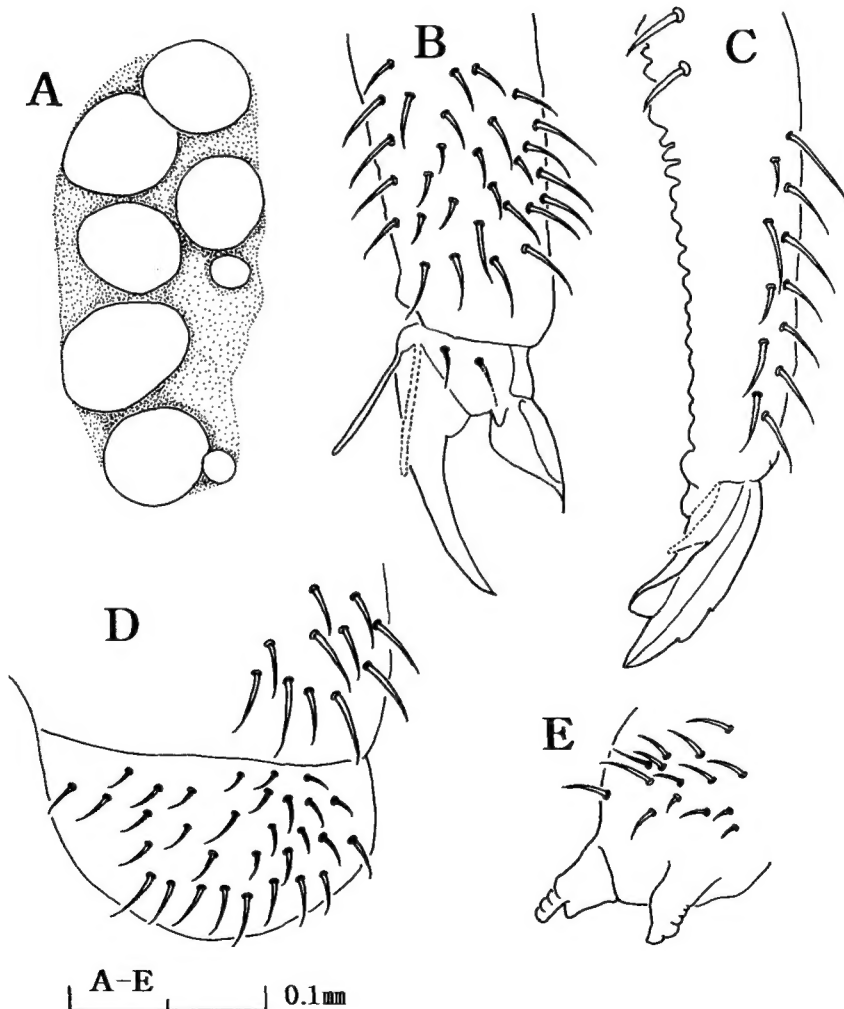


Fig. 2. *Axelsonia littoralis* (Moniez, 1890). A, left eye patch; B, mid-claw; C, mucro and dens; D, anterior face of ventral tube; E, tenaculum.

community.

Description. Body up to 3.9 mm long and gray to brown, with head usually lighter. Legs and furca pale. Dorsally, many scattered spots on body a v-shaped mark on the back of the head. Apical bulb of Ant. IV segment absent. Third antennal organ (III AO) with ca. 15~20 sensillae. Postantennal organ (PAO) absent. Eye patch with 8 ocelli on each side (Fig. 2A). Labrum with 4 papillae. Unguis with two long spear-like lateral teeth, without inner teeth. Unguiculus broad, toothless. Tennent hair absent (Fig. 2B). Lateral flap of the ventral tube with numerous setae (Fig. 2D). Tenaculum quadridentate, with ca. 15~20 setae (Fig. 2E). Manubrium both dorsally and ventrally with many setae. Dentes crenulated dorsally with numerous setae. Mucro slender with 5 teeth (Fig. 2C).

Remarks. Our specimens agreed well with the description by Yosii (1955, 1966). However, the body size of our materials is much larger (average 3.5 mm) than the cited one. This species was collected for our ecological survey in 1998 and 1999. This is a new record for Korea. This species is marine intertidal animal.

Distributions. cosmopolitan; Europe (England, France, Italy, Finland), N. Africa (Morocco), Madagascar, Australia, Japan, Indo-China, Korea.

Family Entomobryidae

3. *Sinella* (s. str.) *straminea* (Folsom, 1899) 주름개미집발톱톡토기 (신칭) (Fig. 3)

Entomobrya straminea: Folsom, 1899.

Sinella straminea: Börner, 1903; Denis, 1929; Stach, 1964.

Material examined. 3♀, Jokumdari, Songhyön-ri, Mangun-myön, Muan-gun, Cöllanam-do, 18 Apr. 1998, collected from the nests of ant (*Tetramorium caespitum*) under needle litter of pine trees.

Description. Body length up to 1.8 mm. Quite white alive and in alcohol. Ant. : Hd. as 2 : 1. Ant. IV without apical bulb, subapical rod vestigially small. 3rd antennal organ is two short curved rods. Eyes 3+3, two anterior of them lie somewhat obliquely touching each other, the third at a distance behind them. Labral setae 4/5, 5, 4, all smooth and labral margin without papillae (Fig. 3F). Labial setae all smooth. Tennent hair is pointed apically somewhat shorter than the ventral lamella of the unguis. Unguis carinate, with an inner distal and a pair of broad inner basal teeth, and outer one of the latter is very large, wing-like, while the inner one is low, small and inconspicuous. Unguiculus with a large wing-like outer tooth (Fig. 3D). Tibiotarsus of hind leg bears a large p-seta (Fig. 3G), and with a double row of finely ciliate setae along the ventral side of all legs (Fig. 3D). These straight bristles strong contrast to others. Trochanteral organ is composed of 16 spiny setae, those of the posterior margin are elongate and large, but others are small or minute. The anterior face of ventral tube has 2+2 large and 5+5 feeble ciliate setae symmetrically arranged (Fig. 3C). Posterior face bears 2+2 terminal and 3+3 minute setae (Fig. 3E). Lateral flap bears 8 smooth setae. Tenaculum quadridentate, with a seta. Manubrium dorsally only with ciliated setae. Mucro bidentate with a basal spine, apical tooth 2~2.5 times as long as anteapical (Fig. 3B). Arrangement of larger body setae on Th. II~Abd. III. as shown in Fig. 3A.

Remarks. Our specimens agreed in general characteristics with the description by Stach (1964) from China. In my specimens the arrangement of macrosetae on the Abd. IV is the same as given by Yosii (1956) for *Sinella curviseta* Brook. However, the setae of ventral tube differ from that

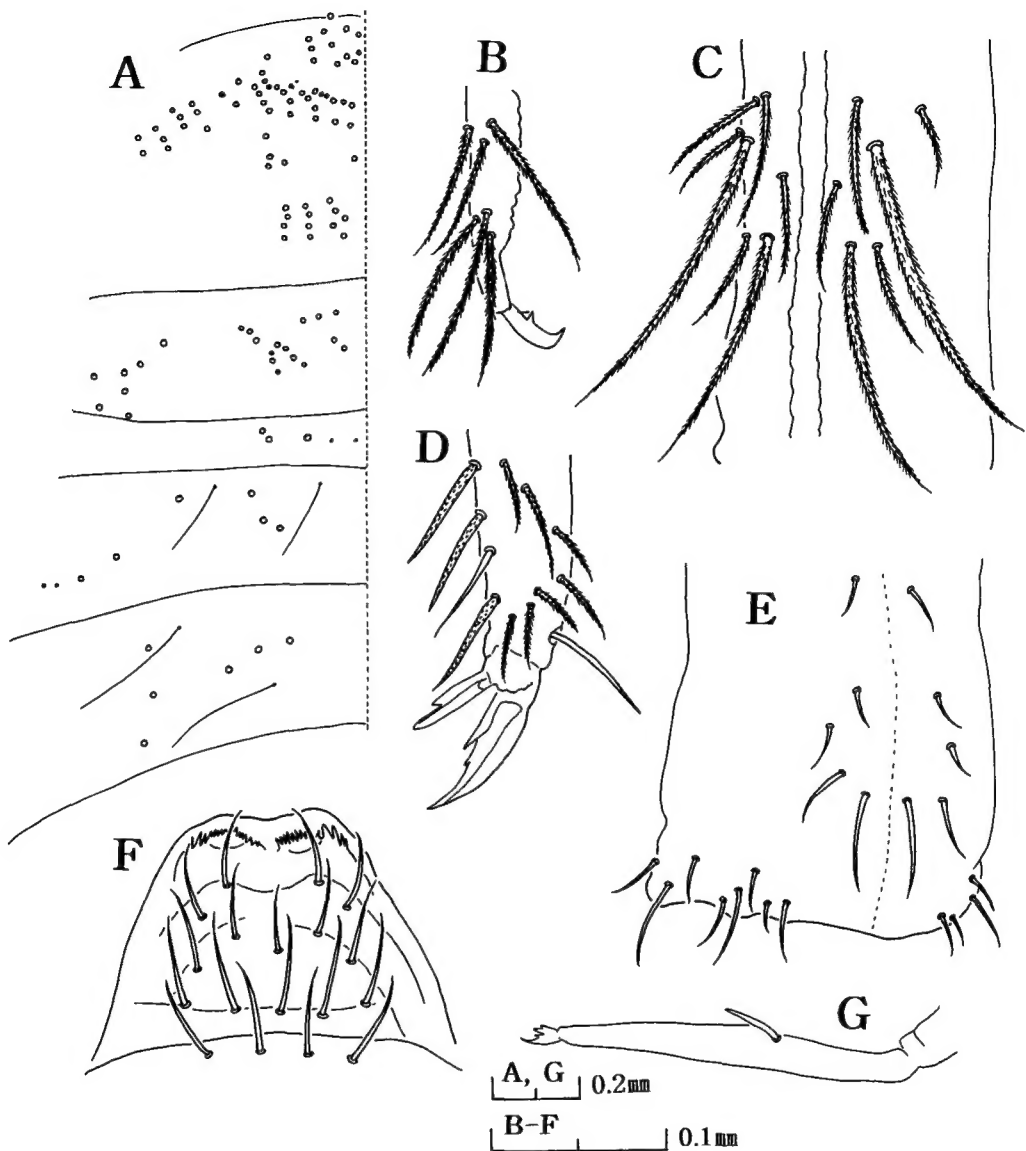


Fig. 3. *Sinella* (s. str.) *straminea* (Folsom, 1899). A, chaetotaxy of Th. II - Abd. III; B, mucro; C, anterior face of ventral tube; D, apical part of third leg from inner side; E, ventral tube (posterior view); F, labrum; G, hind tibiotarsus.

figured by Yosii (1964) from Japan, all setae of anterior face in my specimen are feathery. This is a new record for Korea.

Distributions. Japan, China, Korea.

4. *Sinella* (s. str.) *coeca* (Schött, 1899) 쌍구개미집발톱톡토기 (신칭)

Sinella coeca: Yosii, 1956; Stach, 1964.

Material examined. 5♀, near the Jokumdari, Songhyŏn-ri, Mangun-myŏn, Muan-gun, Chŏllanam-do, 18 Apr. 1998, collected from the nests of ant (*Messor aciculatus*) under lawn.

Remarks. Korean specimens coincide well with the description by Stach (1964) from China, except the tenent hair is lightly clavate at the tip in my specimens. Chaetal arrangement of large setae are not different from other species of the genus (Yosii, 1956). This is a new record for Korea.

Distributions. cosmopolitan, Korea.

5. *Entomobrya marginata* (Tullberg, 1871) 선두리털보톡토기 (신칭)

Degeeria marginata: Tullberg, 1871.

Entomobrya marginata: Stach, 1947, 1963.

Material examined. 2♂, 2♀, Uido island, Tocho-myŏn, Shin-an gun, Chŏllanam-do, 14-15 Jun. 1997, collected from *Vitex rotundifolia* community of sand beaches and from pine litter of sand dune.

Remarks. Our collection agreed well with the description of Poland material by Stach (1963). The stripes at posterior margins of all tergites, however, become often very narrow, less visible and sometimes entirely absent. It is a member of lawland-fauna, appearing only at low and medium altitudes. This is a new record for Korea.

Distributions. Poland, Slovakia, Hungary, Roumania, Austria, Styria, Albania, Malta, Kuban SSR, China, Korea.

6. *Entomobrya vigintisetata* Lee and Park, 1984 스펀털보톡토기

Entomobrya vigintisetata: Lee and Park, 1984; Kim and Lee, 1995.

Material examined. 10♂, 12♀, sand beach of Tongho, Haeri-myŏn, Koch'ang-gun, Chŏllanam-do, collected from *Phacelurus latifolia* community of upper intertidal zone (23 May 1998) and under rice straw (28 Mar. 1998).

Remarks. Our collection agreed entirely with the description by Lee and Park (1984) for Korean materials from sand beach of Daechŏn. This species is considered as a halophilous species.

Distribution. Korea.

7. *Homidia mediaseta* Lee and Lee, 1981 줄무늬보톡토기

Homidia mediaseta: Lee and Lee, 1981.

Material examined. 7♂, 15♀, Uido island, Tocho-myŏn, Shin-an gun, Chŏllanam-do, 14 Jun. 1997, collected from pine litter of sand dune; 5♂, 10♀, near the Jokumdari, Songhyŏn-ri, Mangun-myŏn, Muan-gun, Chŏllanam-do, 18 Apr. 1998, collected from pine litter.

Remarks. This species was recorded from South Korea by Lee and Lee (1981). The present materials agreed entirely with the description and figures of those given by the original paper.

Distribution. Korea.

8. *Willowsia bimaculata* (Börner, 1909) 쌍무늬비늘털보톡토기 (신칭)

Sira bimaculata: Yosii, 1942.

Willowsia bimaculata: Uchida, 1969.

Ptenura bimaculata: Börner, 1909.

Remarks. This species agreed well with the descriptions by Yosii (1942) and Uchida (1969) from Japanese materials. Labral setae 4/5, 5, 4 and labral margin with papillae. This is a new record for Korea.

Material examined. 2 ♀, Dukgua-myön, Namwon-gun, Chollabuk-do, 21 Aug. 1998, from pear trees of a fruit garden; 10 ♂, 20 ♀, Kwangju City, 6 Feb. 2000, collected from dry cultivated plants.

Distributions. Japan, Korea.

DISCUSSION

We gave the descriptions of six species new to Korea, in addition to simple remarks for two species on record. Among them are four intertidal forms of Collembola from salt marshes and sand beach in South Korea, of which three species (*Oudemansia esakii*, *Axelsonia littoralis*, and *Entomobrya marginata*) are new to Korea. *Oudemansia esakii* and *Axelsonia littoralis* are cosmopolitans and were reported as halophilous, inhabiting salt marshes in Japan and U.S.A (Yosii 1955, 1958, 1966; Christiansen and Bellinger 1998). So far nineteen halophilous species of Collembola, including those described in the present paper were reported from the Korean Peninsula.

Collembola interact with many other terrestrial invertebrates (Hopkin, 1997). Many species of Collembola occur in nests of eusocial insects where they are tolerated by their hosts and sheltered from climatic extremes and predators (Stebaeva, 1989; Hopkin, 1997). The springtails apparently do no harm and appear to feed on detritus within the nests (Hölldobler and Wilson, 1990). Until now, although some Collembolan species from various countries have been recorded from nest of ants, no species have been reported from Korea. In the present study, however, we observed two species (*Sinella coeca*, *Sinella straminea*) inhabiting the nests of two ant species (*Tetramorium caespitum* (Linné) and *Messor aciculatus* (Smith)). These two ant species seem to depend on seed harvesting for most of their food, because a large number of grass seeds were observed from the nests. They are considered, therefore, not predating on Collembola. Among the two Collembolan species, *Sinella coeca* was already reported from ant nests in China (Stach, 1964).

Willowsia bimaculata was collected from dry cultivated plants, and from pear trees. Collembola consume a wide variety of food materials. Most species of Collembola graze fungi from various sources including the surfaces of decaying leaves, fecal pellets and soil particles (Anderson and Ineson, 1984; Greenslade, 1991; Ponge, 1991). A major beneficial effect of Collembolan feeding activity on fungal hyphae is the promotion of decomposition processes in soils (Rusek, 1975). In other situations, Collembola may reduce disease by consuming pest fungi. For these reasons, certainly, we could see a lot of hyphae of mycorrhizal fungi from the gut of *Willowsia bimaculata*.

Oudemansia, *Axelsonia* and *Willowsia* were confirmed to be genera of new to Korea. The present study bring the Korean faunal list of Collembola to 203 species in 10 families.

REFERENCES

- Anderson, J. M. and P. Ineson, 1984. Interactions between soil arthropods and microorganism in carbon, nitrogen and mineral element fluxes from decomposing leaf litter. In *Nitrogen as an Ecological Factor* (ed. J. Lee and S. McNeill), pp. 413-432. Blackwell, Oxford.
- Börner, V. C., 1903. Ueber eine altweltliche Collembolen nebst Beschreibungen zur Systematik der Isotominen usw. *SB. Ges. naturf. Fr.*, pp. 129-182.
- Börner, V. C., 1909. Japans Collembolen fauna. *Sitzungsben. Gesell. Naturforsch. Freunde. Berlin*, pp. 99-135.
- Christiansen, K. and P. Bellinger, 1992. *Insects of Hawaii*, Vol. 15, Collembola. Univ. of Hawaii Press, Honolulu.
- Christiansen, K. and P. Bellinger, 1998. *The Collembola of North America, North of the Rio Grande*. Grinnell College, Grinnell, Iowa. 439 pp.
- Denis, J. R., 1923. Notes sur les Aptérygotes. *Ann. Soc. Ent. France, Paris*, **92**: 209-246.
- Denis, J. R., 1924. Sur les Collemboles du Muséum de Paris. *Ann. Soc. Ent. France, Paris*, **93**: 211-260.
- Denis, J. R., 1929. Seconde note sur les Collemboles d'Extrême Orient. Notes sur les Collemboles recoltés dans ses voyages par le Prof. F. Silvestri (II). *Boll. Lab. Portici*, **22**: 305-332.
- Folsom, J. W., 1899. Japanese Collembola. *Proc. Amer. Acad. Arts a. Sc.*, **34**(9): 261-274.
- Gisin, H., 1960. *Collembolenfauna Europas*. Geneve, 312 pp.
- Greenslade, P., 1991. Collembola (springtails). In: *Insects of Australia*. Vol. 1 (2nd ed.) (ed. CSIRO) Carlton: Melbourne Univ. Press, pp. 252-264.
- Hölldobler, B. and E. O. Wilson, 1990. *The ants*. Springer Verlag, 732 pp.
- Hopkin, S. P., 1997. *Biology of the springtails (Insecta: Collembola)*. Oxford Univ. Press, 330 pp.
- Kim, J.-T. and B.-H. Lee, 1995. Collembola (Insecta) from Is. Chin-do, Korea. *Kor. J. Syst. Zool.*, **11**(4): 447-453.
- Kinoshita, S., 1932. Collembola. *Iconogr. Ins. Jap.*, pp. 2115-2123. Hokuryukan. Tokyo.
- Lee, B.-H. and W. K. Lee, 1981. A taxonomic study of soil microarthropods with reference to *Homidia* (Collembola) and *Oribatei* (Acari). *Ann. Rep. Biol. Res.*, **2**: 129-140.
- Lee, B.-H. and K.-H. Park, 1984. Some Entomobryidae including six new species and one new record of cave form (Collembola) from Korea. *Kor. J. Zool.*, **27**(9) : 177-188.
- Lee, B.-H. and K.-H. Park, 1986. Three new species of Onychiuridae (Collembola) from a Korean cave. *Kor. J. Syst. Zool.*, **2**(1): 11-20.
- Lee, B.-H. and K.-H. Park, 1992. Collembola from North Korea, II. Entomobryidae and Tomoceridae. *Folia Entomol. Hungarica*, **53**: 93-111.
- Moniez, R., 1890. Acariens et insectes marins des côtes du Boulonnais. *Rev. Biol. Nord Fr.*, **2**: 149-408.
- Park, K.-H. and B.-H. Lee, 1995. Tomocerid Collembola (Insecta) from Korean caves including a new species. *Kor. J. Syst. Zool.*, **11**(4): 435-446.
- Ponge, J. F., 1991. Succession of fungi and fauna during decomposition of needles in a small area of Scots pine litter. *Plant and Soil*, **138**: 99-113.
- Rusek, J., 1975. Die bodenbildende Funktion von Collembolen und Acarina. *Pedobiol.*, **15**: 299-308.
- Schött, H., 1899. Zur Systematik und Verbreitung paläarktischer Collembola. *Sven. Vet.-Akad. Händl. (B)*, **25**:

1-100.

- Stach, J., 1947. The apterygotan fauna of Poland in relation to the world fauna of this group of insects. Family Isotomidae. Acta Monogr. Mus. Hist. Natur. Kraków, pp. 1-488.
- Stach, J., 1963. The Aptetygotan fauna of Poland in relation to the world-fauna of this group of insects. Tribe : Entonobryini. Acta Monogr. Mus. Hist. Natur. Kraków, 126 pp.
- Stach, J., 1964. Materials to the knowledge of Chinese Collembola fauna. Acta Zool. Cracov., **9**(1): 1-26.
- Stebaeva, S. K., 1989. Landscape-zonal ecological niche of *Xenylla* species in the USSR. In Third International Seminar on Apterygota (ed. R. Dallai). p. 405-412. Univ. of Siena, Siena.
- Tullberg, T., 1871. Förteckning öfver svensk Podurider. Öfv. Vet.-Akad. Förh., **28**: 143-155.
- Uchida, H., 1969. Studies on the Arboreal Collembola I. Sci. Rep. Hirosaki Univ., **16**: 12-29.
- Yosii, R., 1942. Japanische Entomobryinen (Ins., Collemb.). Archiv Für Natur. N. F., **10**(4): 476-495.
- Yosii, R., 1955. Meeresinsekten der Tokara Inseln VI. Collembolen. Publ. Seto Mar. Biol. Lab., **4**: 379-401.
- Yosii, R., 1956. Monographie zur Höhlencollembolen Japans. Contrig. Biol. Lab. Kyoto Univ., **3**: 1-109.
- Yosii, R., 1958. On some remarkable Collembola from Japan. Acta Zool. Cracov., **2**: 681-705.
- Yosii, R., 1960. Studies on the Collembolen genus *Hypogastrura*. Am. Midland Natural., **64**(2): 257-281.
- Yosii, R., 1964. Some Collembola from Okinawa caves, with Notes on *Sinella-Coecobrya* Complex of Japan. Bull. Akiyoshidai Sci. Mus., **3**: 25-34.
- Yosii, R., 1966. On some Collembola of Afghanistan, India and Ceylon, collected by the KUPHE-Expedition 1960. Res. Kyoto Univ. Sci. Exped. Karakoram Hindukush, **8**: 333-405.
- Yosii, R., 1971. Collembola of Khumbu Himal. Khumbu Himal. Bd., **4**(1): 80-130.

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개미집 공서종 2종을 포함하는 한국산 톡토기류 (곤충강)의 6미기록종

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요 약

남한의 수 개 지역에서 채집한 3과 8종의 톡토기 가운데 6종 (*Oudemansia esakii* (Kinoshita, 1932), *Axelsonia littoralis* (Moniez, 1890), *Sinella* (s. str.) *straminea* (Folsom, 1899), *Sinella* (s. str.) *coeca* (Schött, 1899), *Entomobrya marginata* (Tullberg, 1871), *Willowsia bimaculata* (Börner, 1909))이 한국 미기록종으로 판명되어 보고한다. 이 중 *Oudemansia esakii*, *Axelsonia littoralis*와 *Entomobrya marginata* 3종은 호염성이고, *Sinella straminea*와 *Sinella coeca*는 개미집에서 채집되었다. *Sinella*속의 2종은 한반도에서 개미집으로부터 채집된 톡토기의 첫 보고이다. 본 조사 결과 한국산 톡토기는 모두 10과 204종에 이른다.